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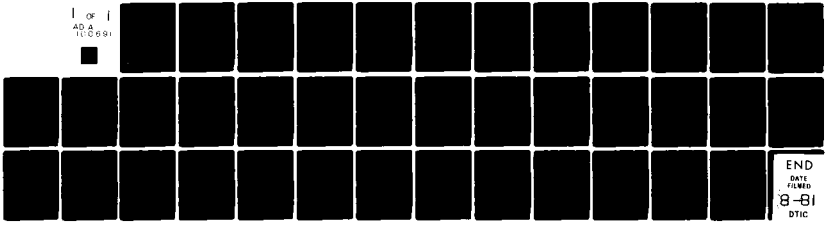
HELICOPTER NOISE EXPOSURE LEVEL DATA: VARIATIONS WITH TEST TARG--ETC(U)
JUL 80 J S NEWMAN
UNCLASSIFIED FAA-AEE-80-34 NL



Department of Transportation
Federal Aviation Administration

Office Of Environment And Energy
Washington D.C. 20591

Helicopter Noise Exposure Level Data:

Variations With Test Target

- Indicated Airspeed
- Distance
- Main Rotor RPM

And

- Takeoff Power

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J. Steven Newman

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FOREWORD AND ACKNOWLEDGMENT

This report provides uncorrected noise exposure level data measured using an integrating sound level meter at a single measurement location during the recently completed, week long, FAA helicopter noise test.

These data have been acquired as a result of the combined efforts of many individuals, including the following persons who played key roles in conducting the program.

Larry Bedore - NEL measurements

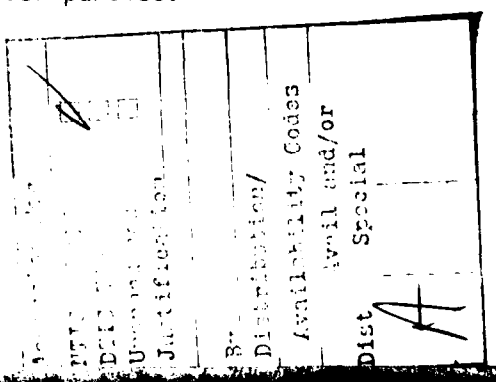
Dave Ford - Cockpit coordination

Ed Sellman - Range control coordination

Dave Smith - Tower coordination

In addition to the measurements ~~hereip~~ reported, primary acoustical measurements ~~have~~ been conducted by the Transportation Systems Center Noise Measurement and Assessment Laboratory under the direction of E. J. Rickley. This acoustical data (acquired for nine microphones) will be combined with flight path track data processed at the FAA, Dulles Noise Laboratory by D. W. Ford. Meteorological data acquired from surface readings and radiosondes will be processed by U.S. Weather Service personnel.

The coalation and reporting of these data will require a considerable period of time. Thus, this report has been prepared to provide limited but nevertheless useful information to interested parties.



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LIST OF SYMBOLS AND ABBREVIATIONS

Avg.	=	Arithmetic Average of Sample Values
B & K	=	Bruel and Kjaer (2218) Precision Sound Level Meter
dB(A)	=	Maximum, Slow Response, A-Weighted Sound Level Expressed in Decibels
GR	=	General Radio (1565) Precision Sound Level Meter
H	=	Hover Power
NEL	=	Noise Exposure Level
RPM	=	Revolution Per Minute
Std.Dev.	=	Standard Deviation
V_H	=	Maximum Speed in Level Flight with Maximum Continuous Power (Knots)
V_{NE}	=	Never Exceed Speed (Knots)
V_y +10	=	Best Rate of Climb Speed Plus 10 Knots
V_y -10	=	Best Rate of Climb Speed Minus 10 Knots
V_y	=	Best Rate of Climb Speed
Kt.	=	Knots
AGL	=	Above Ground Level

Note. In the context of this report the Sound Exposure Level (SEL) is considered synonomous with NEL.

1.0 INTRODUCTION

This report has been prepared in a short time frame in order to provide a "first look" at data acquired in the FAA helicopter noise measurement program conducted at the FAA Technical Center during the week of June 21, 1980. Subsequent reports will provide extensive meteorological data, tracking data, normalized acoustical data, and analysis.

1.1 Noise Exposure Level Data

The Noise Exposure Level (NEL) data reported in this document were measured primarily with the GenRad 1988 precision integrating sound level meter. The Bruel and Kjaer 2218 was used for the 206-L measurements.

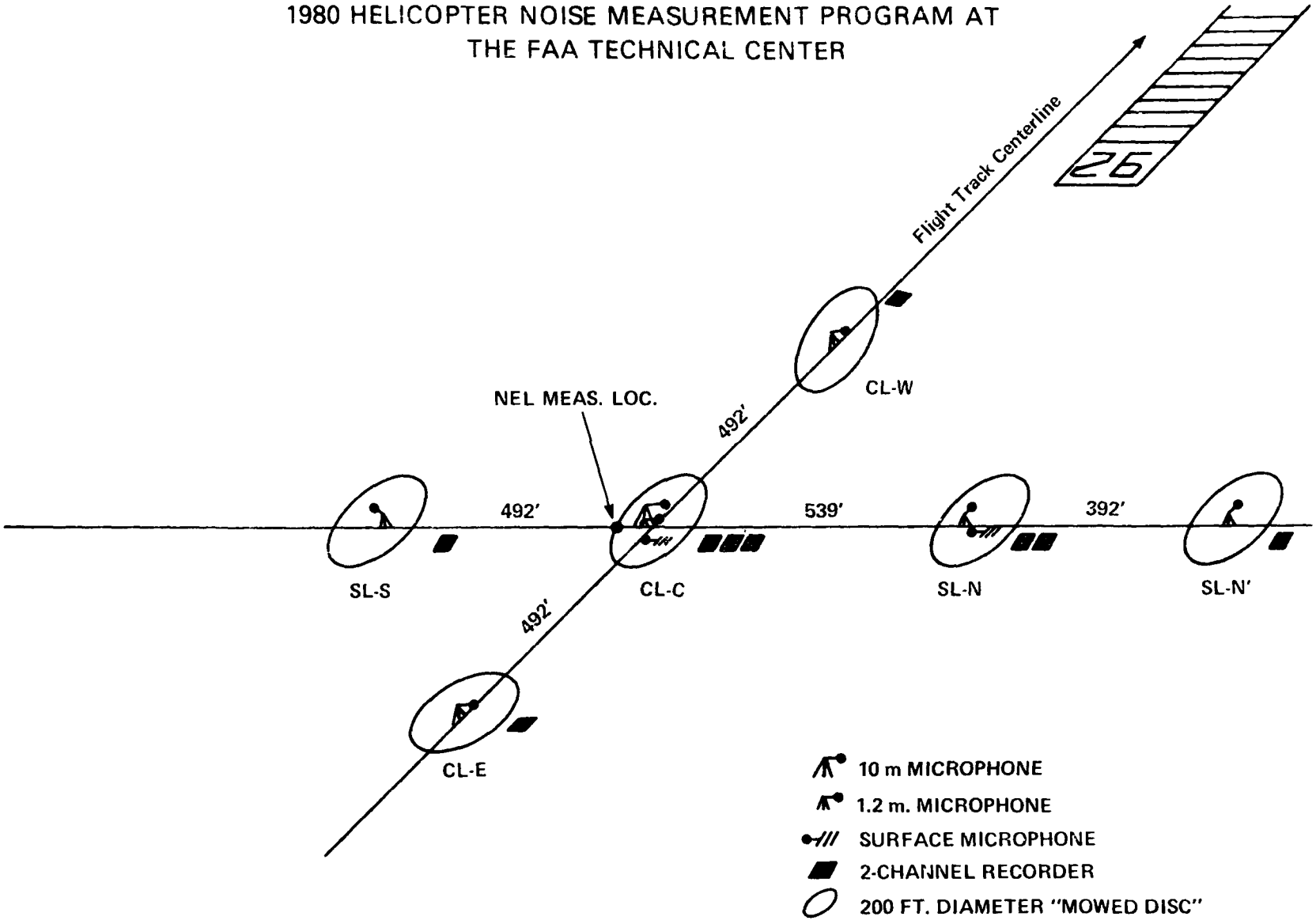
NEL readings were measured over approximately the 20 dB down, time history for each event. Readings were measured 4 feet above ground level at a distance of approximately 100 feet to the side of the centerline - center microphone location (see Figure 1.1).

1.2 A-Weighted Sound Level Data

The maximum, slow response A-weighted sound level is presented along with the NEL for each event.

Figure 1.1

MICROPHONE AND RECORDING SYSTEM DEPLOYMENT; JUNE 1980 HELICOPTER NOISE MEASUREMENT PROGRAM AT THE FAA TECHNICAL CENTER



1.3.0 Flight Paths - Speeds - Main Rotor RPM

The NEL data have been presented for TARGET testing parameters. The tracking data, meteorological data, and cockpit photographs have not yet been reduced. However, examination of the NEL data variability within any given test series does provide an ideal of how consistent conditions were.

1.3.1 Takeoff Profile

The takeoff rotation point for the UH-60A on 6-22 was 1,632 feet from the centerline-center microphone location (takeoffs east to west). During the remainder of the test, the takeoff rotation point was 1,561 feet from the centerline-center microphone location (takeoffs west to east).

1.3.2 Approach Profile

Approaches were conducted along a 6 degree glide slope, intercepting the ground surface 3,750 feet to the west of the centerline-center microphone location.

1.4 Statistical Analysis

The arithmetic average and the standard deviation have been provided for each data sample. Subsequent analysis will include consideration of small sample statistics.

1.5 Data Plots

The speed versus noise and distance versus noise plots provided in this report include trend lines which are eye-ball/French curve approximations of the ordinate-abscissa relationship. After subsequent data correction and analysis, a thorough correlation and regression analysis will be conducted.

1.6 NEL-dB(A) Data

The difference between the average NEL and average maximum dB(A) has been provided for each data set. The use of this data in assessing the duration correction relationship is not recommended until data corrections are applied.

1.7 Comparison of Average Takeoff, Approach, and Level Flyover Data

Table 1.7 provides a comparison of noise exposure levels for the various test helicopters in a variety of operational modes.

1.8 Analysis Benefit

The absolute values of uncorrected measured data may be different from rigorously normalized data, however, the trends, slopes and mathematical functions relating NEL with speed, distance and other parameters should be similar to those derived from corrected data.

TABLE 1.7

AVERAGE NOISE EXPOSURE LEVEL (dB):

COMPARISON OF TAKEOFF APPROACH

AND LEVEL FLYOVER DATA

Helicopter	Takeoff	Approach	Level Flyover	Test Weight
S-76 (100%)	85.6	93.3	86.3	10,000 lbs
S-76 (107%)	87.5	95.5	88.5	10,000 lbs
A109	91.6	98.2	89.8	5,730 lbs
UH-60A (V_y +10)	-	94.0	-	20,250 lbs
UH-60A (V_y -10)	-	93.4	-	20,250 lbs
UH-60A (V_y)	-	93.1	-	20,250 lbs
UH-60A (6-22) (Max. Pwr.) (V_y)	84.6	94.1	93.5	20,250 lbs
UH-60A (6-26) (H + 10%)	87.0	-	-	20,250 lbs
UH-60A (6-26) (Max. Pwr.)	86.6	-	-	20,250 lbs

2.0 SIKORSKY UH-60A "BLACKHAWK"

The UH-60A was provided through the courtesy of the U.S. Army Transportation School located at Ft. Eustis, Virginia.

The UH-60A was utilized to investigate the following influences on noise levels:

1) Distance (level flyovers)
2) Speed (level flyovers and approach)
3) Engine power (takeoff)

NEL and maximum dB(A) data are also provided for takeoffs, approaches and level flyovers utilizing proposed helicopter noise certification procedures.

TABLE 2.1

UH-60A: TEST DATE 6/22/80 (SUNDAY)

CENTERLINE CENTER LOCATION (GR)

NOISE EXPOSURE LEVEL FOR TAKEOFF AND APPROACH

Takeoff			Approach		
Run No.	NEL	Max. dB(A)	Run No.	NEL	Max. dB(A)
7	85.1	74.4	16	93.8	85.9
8	85.4	76.3	17	94.6	86.8
9	85.1	75.0	18	94.0	85.8
10	84.4	74.3	19	93.6	85.1
11	84.2	73.2	20	94.3	86.4
12	84.5	74.4	21	94.2	85.8
13	84.7	74.5	22	94.3	86.3
14	84.1	73.5	23	94.2	86.4
15	84.1	74.3	24	94.3	86.7
Avg.	84.6	74.4	Avg.	94.1	86.1
Std. Dev.	0.48	0.88	Std. Dev.	0.30	0.53

$\overline{NEL} - \overline{dB(A)} = 10.2$ $\overline{NEL} - \overline{dB(A)} = 8.0$

TABLE 2.2

UH60A: TEST DATE 6/22/80 (SUNDAY)

CENTERLINE CENTER LOCATION (GR)

NOISE EXPOSURE LEVEL VERSUS

INDICATED AIRSPEED FOR 500' LEVEL FLYOVERS

165 Kts			152 Kts			132 Kts		
Run No.	NEL	Max. dB(A)	Run No.	NEL	Max. dB(A)	Run No.	NEL	Max. dB(A)
49	93.6	78.5	25	92.4	84.4	26	91.1	-
50	94.7	78.2	28	92.6	84.4	29	92.0	84.0
51	92.7	76.5	31	93.5	85.8	32	91.5	84.3
			34	95.6	87.9	35	91.4	87.9
Avg.	93.6	77.7	Avg.	93.5	85.6	Avg.	91.5	85.4
S. Dev.	1.0	1.07	S.Dev.	1.46	1.65	S.Dev.	.374	2.17

$\overline{NEL} - \overline{dB(A)} = 15.9$ $\overline{NEL} - \overline{dBA} = 7.9$ $\overline{NEL} - \overline{dBA} = 6.1$

115 Kts			100 Kts		
Run No.	NEL	Max. dB(A)	Run No.	NEL	Max. dB(A)
27	90.2	81.7	52	88.0	71.6
30	89.2	80.7			
33	91.4	82.6			
36	90.2	83.2			
Avg.	90.2	82.0			
S.Dev.	0.9	1.09			

$\overline{NEL} - \overline{dB(A)} = 8.2$ $\overline{NEL} - \overline{dB(A)} = 16.4$

Figure 2.2

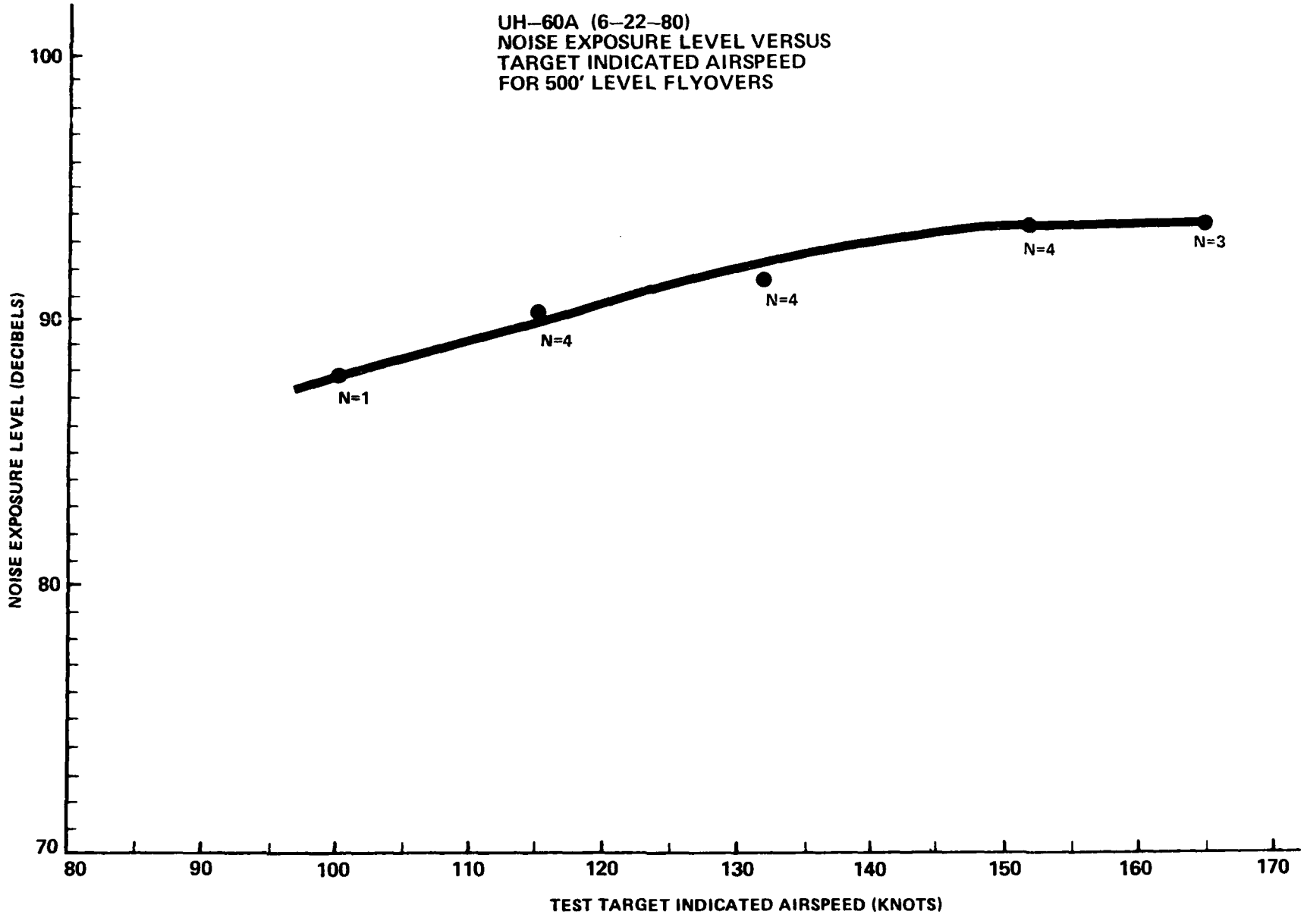

UH–60A (6–22–80)
NOISE EXPOSURE LEVEL VERSUS
TARGET INDICATED AIRSPEED
FOR 500' LEVEL FLYOVERS
NOISE EXPOSURE LEVEL (DECIBELS)
100
90
80
70
N=1
N=4
N=4
N=4
N=3
80
90
100
110
120
130
140
150
160
170
TEST TARGET INDICATED AIRSPEED (KNOTS)

TABLE 2.3

UH-60A: TEST DATE 6/25/80 (WEDNESDAY)

CENTERLINE CENTER LOCATION (GR)

NOISE EXPOSURE LEVEL VERSUS
DISTANCE FOR 152 KNOT LEVEL FLYOVERS

300' AGL			500' AGL			700' AGL		
Run No.	NEL	Max. dB(A)	Run No.	NEL	Max. dB(A)	Run No.	NEL	Max. dB(A)
56	95.6	90.3	25	92.4	84.4	60	-	-
57	97.6	91.7	28	92.6	84 4	61	93.5	84.0
58	96.2	90.7	31	93.5	85.8	62	91.3	82.7
59	99.6	93.1	34	95.6	87.9	63	93.6	84.9
Avg.	97.2	91.4	Avg.	93.5	85.6	Avg.	92.8	83.8
Std.Dev.		1.24	Std.Dev.	1.46	1.43	Std.Dev.	1.1	1.1

$\overline{NEL} - \overline{dBA} = 5.7$ $\overline{NEL} - \overline{dBA} = 7.9$ $\overline{NEL} - \overline{dBA} = 9.0$

1000' AGL			1500' AGL		
Run No.	NEL	Max. dB(A)	Run No.	NEL	Max. dB(A)
64	90.2	81.5	68	86.2	75.4
65	90.8	81.6	69	88.5	77.6
66	89.3	79.9	70	86.4	75.7
67	90.3	81.0	71	88.5	77.7
Avg.	90.1	81.0	Avg.	87.4	76.6
Std. Dev.	.029	.777	Std. Dev.	1.27	1.2

$\overline{NEL} - \overline{dBA} = 9.1$ $\overline{NEL} - \overline{dBA} = 10.8$

2000' AGL			2500' AGL		
Run No.	NEL	Max. dB(A)	Run No.	NEL	Max. dB(A)
72	84.7	74.5	76	-	-
73	85.4	73.0	77	84.7	72.1
74	84.3	72.6			
75	86.0	73.5			
Avg.	85.1	73.4	Avg.	84.7	
Std. Dev.	.752	0.82	Std. Dev.		

$\overline{NEL} - \overline{dBA} = 11.7$ $\overline{NEL} - \overline{dBA} = 12.6$

Figure 2.3

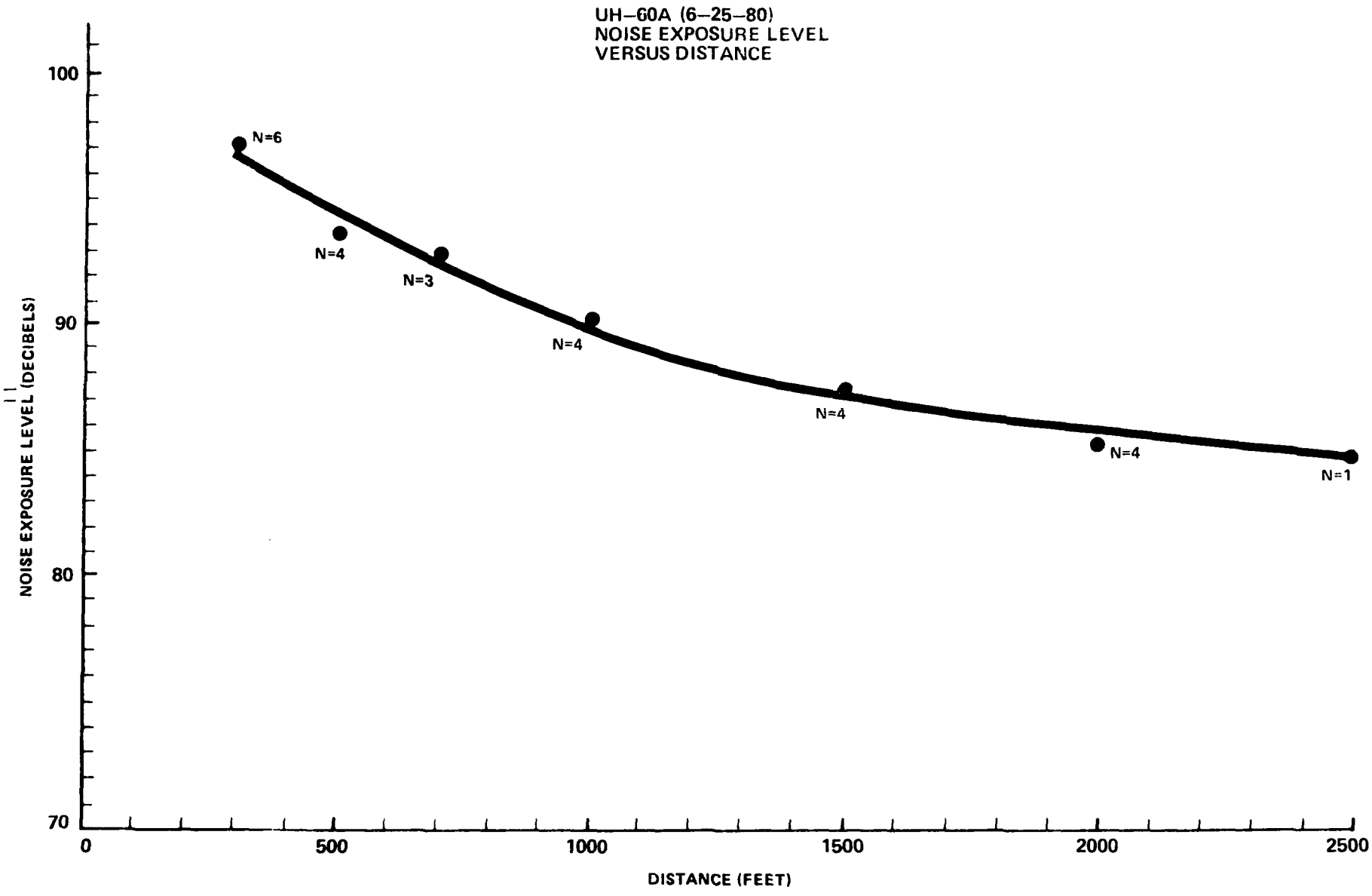

UH–60A (6–25–80)
NOISE EXPOSURE LEVEL
VERSUS DISTANCE
NOISE EXPOSURE LEVEL (DECIBELS)
100
90
80
70
N=6
N=4
N=3
N=4
N=4
N=4
N=1
0
500
1000
1500
2000
2500
DISTANCE (FEET)

TABLE 2.4

UH-60A: TEST DATE 6/26/80 (THURSDAY)

CENTERLINE CENTER LOCATION (GR)

Approach at Vy + 10 Kt.			Approach at Vy - 10 Kt.			Approach at Vy		
Run No.	NEL	Max. dB(A)	Run No.	NEL	Max. dB(A)	Run No.	NEL	Max. dB(A)
22	94.1	86.6	30	94.3	86.6	40	93.1	85.4
24	94.0	87.0	32	93.8	85.2	42	93.2	85.0
26	94.5	86.7	34	92.8	85.2			
28	93.6	86.4	36	93.0	84.9			
			38	93.4	84.6			
Avg.	94.0	86.6	Avg.	93.4	85.3	Avg.	93.1	85.2
Std.Dev.	.36	0.25	Std.Dev.	0.60	0.76	Std.Dev.	.07	0.28
$\overline{NEL} - \overline{dB(A)} = 7.4$			$\overline{NEL} - \overline{dB(A)} = 8.1$			$\overline{NEL} - \overline{dB(A)} = 7.9$		

TABLE 2.5

UH-60A: TEST DATE 6/26/80 (THURSDAY)

CENTERLINE CENTER LOCATION

Takeoff at Hover Power + 10%			Takeoff at Max. Takeoff Power		
Run No.	NEL	Max. dB(A)	Run No.	NEL	Max. dB(A)
21	-		33	86.8	77.8
23	86.9	77.9	35	86.6	77.3
25	87.0	78.2	37	87.1	78.2
27	87.4	78.5	39	86.4	76.5
29	86.6	77.8	41	86.2	76.1
31	87.1	77.9			
Avg.	87.0	78.0	Avg.	86.6	77.1
Std. Dev.	.29	0.28	Std. Dev.	0.34	0.87

$\overline{NEL} - \overline{dB(A)} = 9.0$

$\overline{NEL} - \overline{dB(A)} = 9.5$

3.0 SIKORSKY S-76 "SPIRIT"

The S-76 was provided through the courtesy of the Sikorsky Helicopter Division of United Technologies.

The S-76 was utilized to investigate the following influences on noise levels:

1) Distance (level flyovers)
2) Speed (level flyovers)
3) Main rotor RPM (all flight modes)

NEL and maximum dB(A) data are also provided for takeoffs, approaches and level flyovers utilizing proposed helicopter noise certification procedures.

TABLE 3.1.1

S-76: TEST DATE 6/25/80 (WEDNESDAY)

CENTERLINE CENTER LOCATION

NOISE EXPOSURE LEVEL FOR TAKEOFFS AND APPROACHES USING 107% MAIN ROTOR RPM

Takeoff			Approach		
Run No.	NEL	Max. dB(A)	Run No.	NEL	Max. dB(A)
41	88.3	80.4	40	-	-
43	87.5	80.1	42	96.3	88.1
45	87.1	79.8	44	95.1	85.1
47	87.0	79.6	46	95.2	85.6
49	87.4	79.5	48	95.0	85.6
51	-		50	96.0	87.9
Avg.	87.5	79.8	Avg.	95.5	86.5
Std. Dev.	.46	0.3	Std. Dev.	.53	1.2

$\overline{NEL} - \overline{dB(A)} = 7.7$

$\overline{NEL} - \overline{dB(A)} = 9.0$

TABLE 3.1.2

S-76: TEST DATE 6/23/80 (MONDAY

CENTERLINE CENTER LOCATION

NOISE EXPOSURE LEVEL FOR

TAKEOFFS AND APPROACHES USING

100% MAIN ROTOR RPM

Takeoffs			Approaches		
Run No.	NEL	Max. dB(A)	Run No.	NEL	Max. dB(A)
33	86.0	76.8	34	91.5	81.8
35	86.5	78.1	36	93.5	86.3
37	86.2	77.5	38	94.6	87.6
39	85.3	77.5	40	94.2	86.2
41	85.1	77.3	42	94.0	85.6
43	85.4	77.8	44	92.5	83.7
55	84.5	76.3	56	93.1	85.5
Avg.	85.6	77.4	Avg.	93.3	85.3
Std. Dev.	.64	.56	Std. Dev.	1.0	1.7

$\overline{NEL} - \overline{dB(A)} = 8.2$ $\overline{NEL} - \overline{dB(A)} = 8.0$

TABLE 3.2.1

S-76: TEST DATES 6/23/80 (MONDAY) AND 6/25/80 (WEDNESDAY)

NOISE EXPOSURE LEVEL VERSUS INDICATED AIRSPEED FOR 107% MAIN ROTOR RPM, 500' AGL LEVEL FLYOVERS

155 Kts (M)			140 Kts (M)			124 Kts (W)		
Run No.	NEL	Max. dB(A)	Run No.	NEL	Max. dB(A)	Run No.	NEL	Max. dB(A)
65	92.1	85.8	57	87.7	81.8	24	-	80.5
66	95.3	89.0	58	89.7	82.5	25	86.7	80.4
67	98.0	92.3	59	88.4	81.9	26	89.0	80.8
68	95.3	89.2	60	88.4	81.0	27	89.0	80.0
						28	89.4	81.4
						29	86.4	79.2
Avg.	95.1	89.1	Avg.	88.5	81.8	Avg.	87.7	80.3
Std. Dev.	2.41	2.6	Std. Dev.	.834	.53	Std. Dev.	1.39	0.6
$\overline{NEL} - \overline{dB(A)} = 6.0$			$\overline{NEL} - \overline{dB(A)} = 6.7$			$\overline{NEL} - \overline{dB(A)} = 7.4$		

109 Kts (W)			93 Kts (M)		
Run No.	NEL	Max. dB(A)	Run No.	NEL	Max. dB(A)
18	88.7	79.7	61	85.6	76.5
19	86.2	78.6	62	-	-
20	88.9	80.0	63	85.1	75.8
21	87.4	80.4	64	87.3	79.0
22	89.0	80.6			
23	86.1	78.4			
Avg.	87.7	79.7	Avg.	86.0	77.1
Std. Dev.	1.34	.84	Std. Dev.	1.15	1.3
$\overline{NEL} - \overline{dB(A)} = 8.0$			$\overline{NEL} - \overline{dB(A)} = 8.9$		

TABLE 3.2.2

S-76: TEST DATE 6/23/80 (MONDAY)

CENTERLINE CENTER LOCATION (GR)

NOISE EXPOSURE LEVEL VERSUS

INDICATED AIR SPEED FOR 100% MAIN ROTOR RPM,

500' AGL LEVEL FLYOVERS

155 Kts			140 Kts			124 Kts		
Run No.	NEL	Max. dB(A)	Run No.	NEL	Max. dB(A)	Run No.	NEL	Max. dB(A)
25	88.6	81.5	17	86.9	78.5	49	84.8	78.0
26	87.9	81.6	18	86.3	80.3	50	86.2	78.2
27	90.0	83.4	19	87.1	79.8	51	83.8	76.2
28	89.2	83.0	20	85.7	79.9	52	85.0	76.8
Avg.	88.9	82.4	Avg.	86.3	79.6	Avg.	84.9	77.3
Std. Dev.	.892	.84	Std. Dev.	.632	.67	Std. Dev.	.984	.83

$\overline{NEL} - \overline{dB(A)} = 6.5$ $\overline{NEL} - \overline{dB(A)} = 6.7$ $\overline{NEL} - \overline{dB(A)} = 7.6$

109 Kts			93 Kts		
Run No.	NEL	Max. dB(A)	Run No.	NEL	Max. dB(A)
29	-		21	86.0	75.9
30	83.0	75.5	22	88.9	93.2
31	84.8	75.9	23	85.9	76.5
32	82.5	74.3	24	88.4	81.8
Avg.	83.4	75.2	Avg.	87.3	79.3
Std. Dev.	1.20	.67	Std. Dev.	1.57	3.6

$\overline{NEL} - \overline{dB(A)} = 8.2$ $\overline{NEL} - \overline{dB(A)} = 8.0$

Figure 3.2

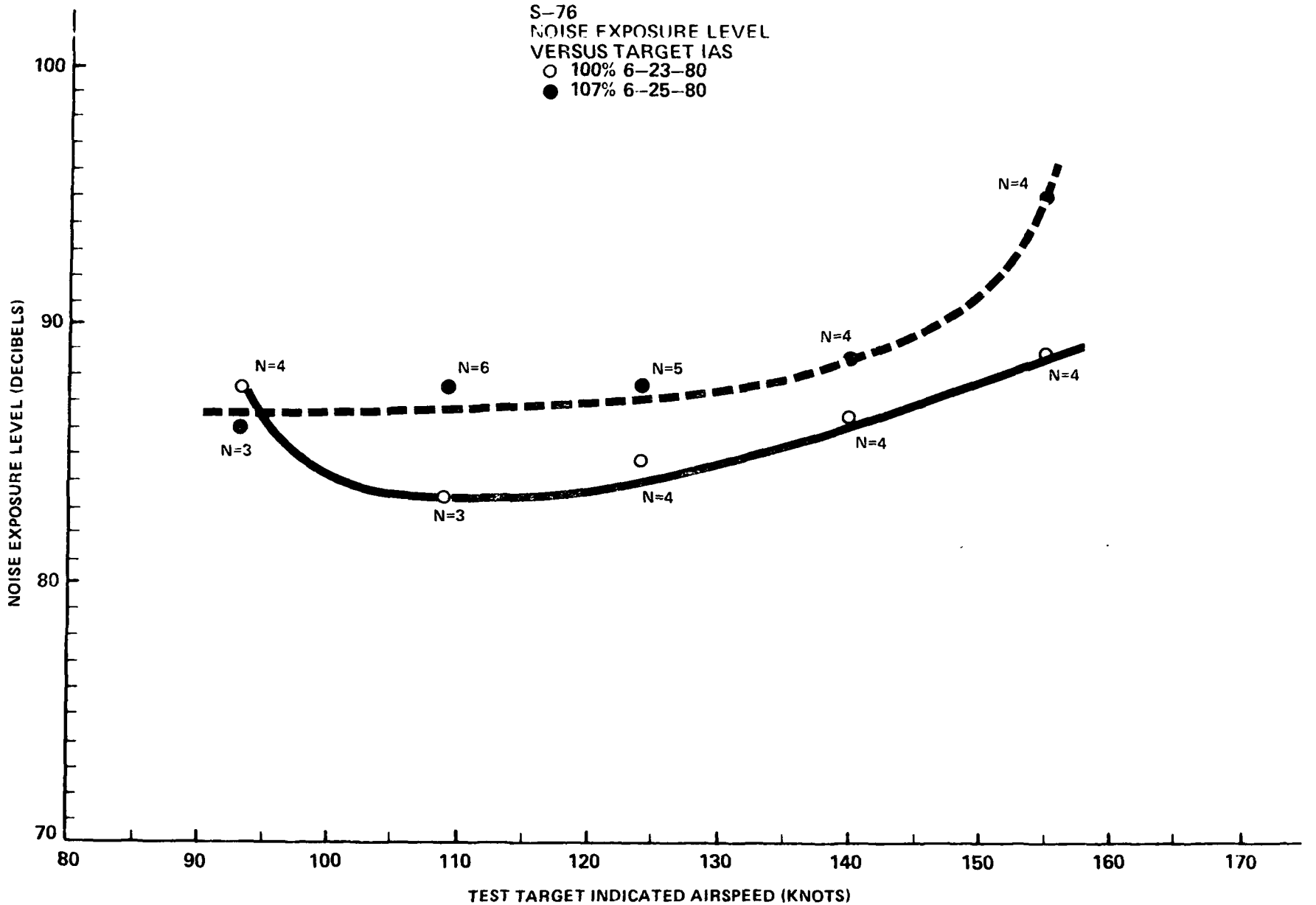

S–76
NOISE EXPOSURE LEVEL
VERSUS TARGET IAS
○ 100% 6–23–80
● 107% 6–25–80
NOISE EXPOSURE LEVEL (DECIBELS)
100
90
80
70
80
90
100
110
120
130
140
150
160
170
TEST TARGET INDICATED AIRSPEED (KNOTS)
N=4
N=6
N=5
N=4
N=4
N=3
N=3
N=4
N=4
N=4

TABLE 3.3.1

S-76: TEST DATE 6/25/80 (WEDNESDAY)

CENTERLINE CENTER LOCATION (GR)

NOISE EXPOSURE LEVEL VERSUS
DISTANCE FOR 107% MAIN ROTOR RPM

300' AGL			500' AGL (6/23)			700' AGL		
Run No.	NEL	Max. dB(A)	Run No.	NEL	Max. dB(A)	Run No	NEL	Max. dB(A)
10	91.9	85.5	57	87.7	81.8	8	88.9	80.1
11	90.5	85.1	58	89.7	82.5	9	86.2	78.9
16	93.1	86.5	59	88.4	81.9	14	87.7	79.0
17	90.1	85.1	60	88.4	81.0	15	86.3	79.0
Avg.	91.4	85.6	Avg.	88.5	81.8	Avg.	87.2	79.3
Std. Dev.	1.37	.57	Std. Dev.	.834	.53	Std. Dev.	1.28	.49

$\overline{NEL} - \overline{dB(A)} = 5.8$ $\overline{NEL} - \overline{dB(A)} = 6.7$ $\overline{NEL} - \overline{dB(A)} = 7.9$

1000' AGL*			1000' AGL*			1500' AGL		
Run No.	NEL	Max. dB(A)	Run No.	NEL	Max. dB(A)	Run No	NEL	Max. dB(A)
1	82.7	74.0	52	85.1	76.3	5	80.3	70.6
2	85.6	76.1	53	84.5	74.8	6	83.1	72.2
3	84.4	76.3	54	86.1	77.1	7	81.2	71.7
4	85.9	76.6	55	85.5	76.7	12	83.5	73.1
						13	81.1	71.6
Avg.	84.6	75.7	Avg.	85.3	76.3	Avg.	81.8	71.9
Std.Dev.	1.45	1.1	Std. Dev.	.673	.08	Std.Dev.	1.38	.81

$\overline{NEL} - \overline{dB(A)} = 8.9$ $\overline{NEL} - \overline{dB(A)} = 9.0$ $\overline{NEL} - \overline{dB(A)} = 9.9$

2000' AGL			2500' AGL		
Run No.	NEL	Max. dB(A)	Run No.	NEL	Max. dB(A)
34	81.7	70.8	30	78.6	66.4
35	79.4	68.4	31	77.6	66.3
36	80.5	68.9	32	79.6	67.7
37	79.4	68.7	33	77.8	66.5
Avg.	80.2	69.2	Avg.	78.4	66.8
Std. Dev.	1.09	.94	Std. Dev.	.909	.56

$\overline{NEL} - \overline{dB(A)} = 11.0$ $\overline{NEL} - \overline{dB(A)} = 11.6$

Note: The 1000' AGL level flyovers were conducted at the beginning and the end of the test session to examine changes in propogation path characteristics.

TABLE 3.3.2

S-76: TEST DATE 6/23/80 (MONDAY)

CENTERLINE CENTER LOCATION

NOISE EXPOSURE LEVEL

VERSUS DISTANCE FOR 100% MAIN ROTOR RPM

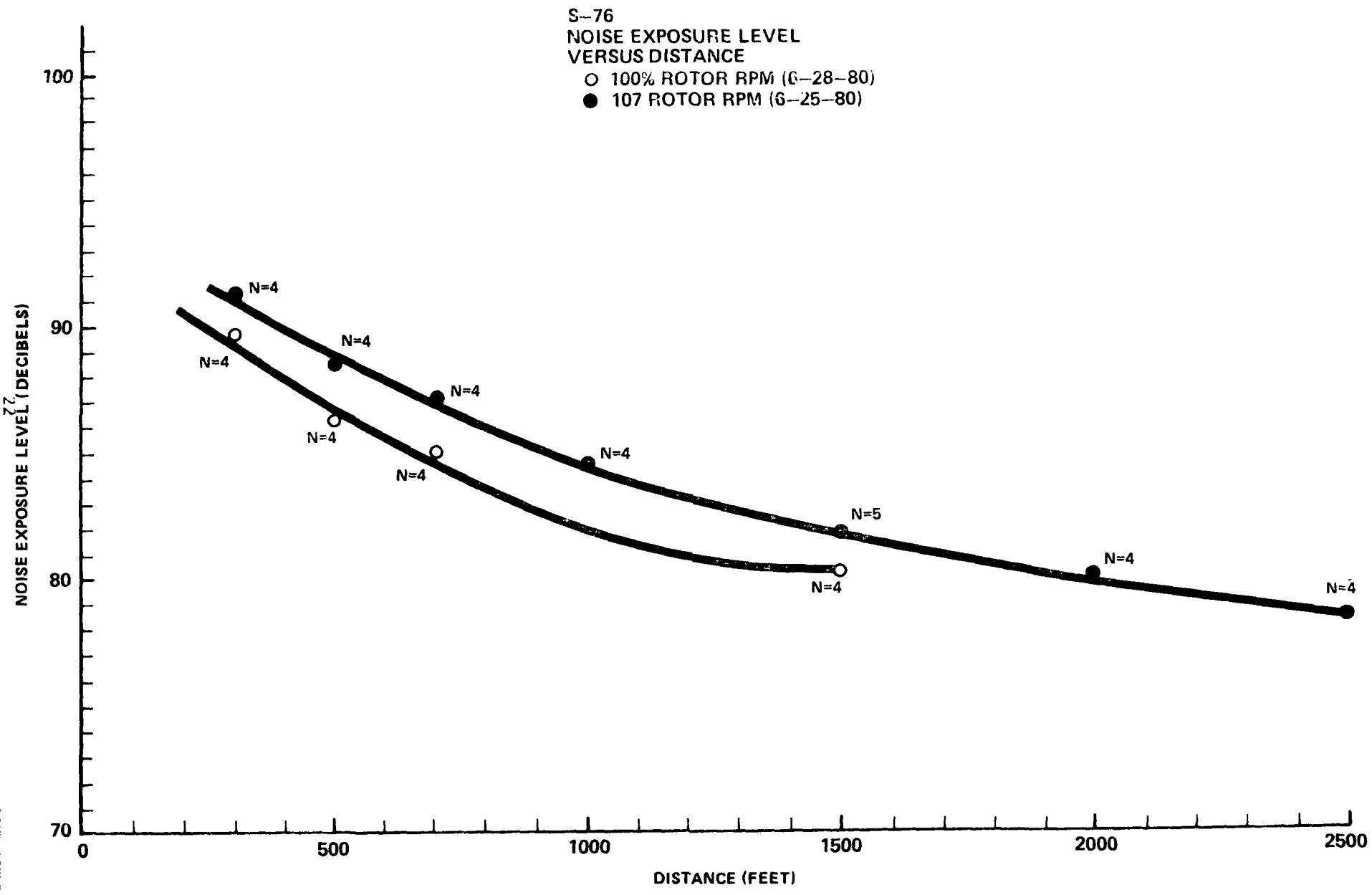
300' AGL			500' AGL			700' AGL		
Run No.	NEL	Max. dB(A)	Run No.	NEL	Max. dB(A)	Run No.	NEL	Max. dB(A)
9	90.7	84.5	17	86.9	78.5	7	85.1	75.5
10	89.1	83.7	18	86.3	80.3	8	84.7	77.2
15	90.0	84.2	19	87.1	79.8	13	85.5	76.5
16	89.3	84.2	20	85.7	79.9	14	85.4	78.2
Avg.	89.7	84.2	Avg.	86.3	79.4	Avg.	85.1	76.9
Std. Dev.	.727	.33	Std.Dev.	.632	.69	Std.Dev.	.359	.98

$\overline{NEL} - \overline{dB(A)} = 5.5$ $\overline{NEL} - \overline{dB(A)} = 6.9$ $\overline{NEL} - \overline{dB(A)} = 8.2$

1000' AGL			1500' AGL		
Run No.	NEL	Max. dB(A)	Run No.	NEL	Max. dB(A)
45	82.3	74.0	5	80.9	69.9
46	82.6	72.6	6	79.9	69.4
47	82.4	74.3	11	80.8	70.3
48	83.4	74.2	12	80.2	70.6
Avg.	82.6	73.8	Avg.	80.4	69.9
Std.Dev.	.43	.69	Std.Dev.	.479	.36

$\overline{NEL} - \overline{dB(A)} = 8.8$ $\overline{NEL} - \overline{dB(A)} = 10.5$

Figure 3.3


S-76
NOISE EXPOSURE LEVEL
VERSUS DISTANCE
100% ROTOR RPM (6-28-80)
107 ROTOR RPM (6-25-80)
NOISE EXPOSURE LEVEL (DECIBELS)
100
90
80
70
0
500
1000
1500
2000
2500
DISTANCE (FEET)
N=4
N=4
N=4
N=4
N=4
N=4
N=4
N=4
N=5
N=4
N=4

4.0 AGUSTA A-109

The A-109 was provided through the courtesy of Costruzioni Aeronautiche, Giovanni Agusta.

The A-109 was utilized to investigate the following influences on noise levels:

1) Distance (level flyovers)
2) Speed (level flyovers)

NEL and maximum dB(A) data are also provided for takeoffs, approaches and level flyovers utilizing proposed helicopter noise certification procedures.

TABLE 4.1

A109: TEST DATE 6/24/80 (TUESDAY)

CENTERLINE CENTER LOCATION (GR)

NOISE EXPOSURE LEVEL FOR

TAKEOFFS AND APPROACHES

Takeoffs			Approaches		
Run No.	NEL	Max. dB(A)	Run No.	NEL	Max. dB(A)
23	91.2	83.7	24	98.3	90.1
25	92.3	88.1	26	97.6	88.1
27	92.3	85.1	28	99.3	91.0
29	91.2	84.2	30	98.6	89.7
31	91.3	84.2	32	98.7	90.5
33	91.1	83.8	34	98.9	89.9
35	91.7	85.1	36	96.2	87.6
37	91.4	84.1	38	97.8	89.7
39	91.5	84.2	40	97.6	89.1
41	91.1	83.6			
Avg.	91.5	84.7	Avg.	98.1	89.5
Std. Dev.	.45	1.3	Std. Dev.	.93	1.09

TABLE 4.2

A109: TEST DATE 6/24/80 (TUESDAY)

CENTERLINE CENTER LOCATION (GR)

NOISE EXPOSURE LEVEL

VERSUS DISTANCE

300' AGL			500' AGL			700' AGL		
Run No.	NEL	Max. dB(A)	Run No.	NEL	Max. dB(A)	Run No.	NEL	Max. dB(A)
9	91.6	84.0	17	88.5	80.1	7	87.2	78.0
10	92.9	85.0	18	90.7	80.9	8	88.6	78.7
15	92.0	84.7	19	89.4	81.3	13	87.6	78.3
16	93.7	85.5	20	90.9	82.0	14	88.4	78.1
			62	90.8	87.7			
			63	88.8	80.5			
Avg.	92.5	84.8	Avg.	89.8	82.1	Avg.	87.9	78.3
Std.Dev.	.938	.54	Std.Dev.	1.08	2.6	Std.Dev.	.66	.27

$\overline{NEL} - \overline{dB(A)} = 7.7$ $\overline{NEL} - \overline{dB(A)} = 7.7$ $\overline{NEL} - \overline{dB(A)} = 9.6$

1000' AGL			1500' AGL		
Run No.	NEL	Max. dB(A)	Run No.	NEL	Max. dB(A)
2	87.3	76.4	5	81.6	70.4
3	85.3	74.6	6	84.9	74.3
4	86.8	76.1	11	81.6	70.1
			12	84.9	72.4
Avg.	86.4	75.7	Avg.	83.2	71.8
Std.Dev.	1.04	.78	Std.Dev.	1.30	1.7

$\overline{NEL} - \overline{dB(A)} = 10.7$ $\overline{NEL} - \overline{dB(A)} = 11.4$

Figure 4.2

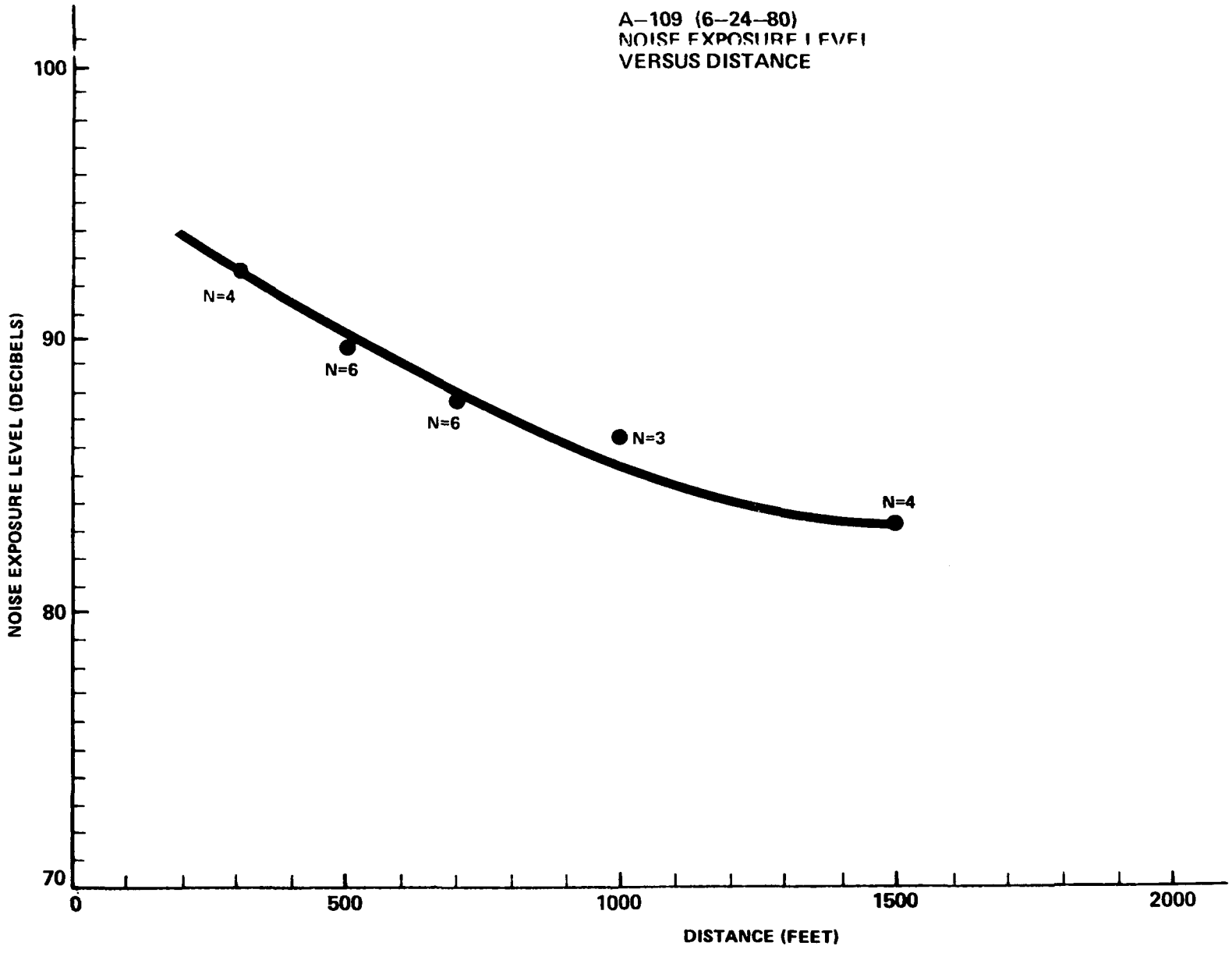

A–109 (6–24–80)
NOISE EXPOSURE LEVEL
VERSUS DISTANCE
NOISE EXPOSURE LEVEL (DECIBELS)
100
90
80
70
N=4
N=6
N=6
N=3
N=4
0
500
1000
1500
2000
DISTANCE (FEET)

TABLE 4.3

A109: TEST DATE 6/24/80 (TUESDAY)

CENTERLINE CENTR LOCATION (GR)

NOISE EXPOSURE LEVEL VERSUS

INDICATED AIRSPEED FOR 500' AGL

LEVEL FLYOVERS

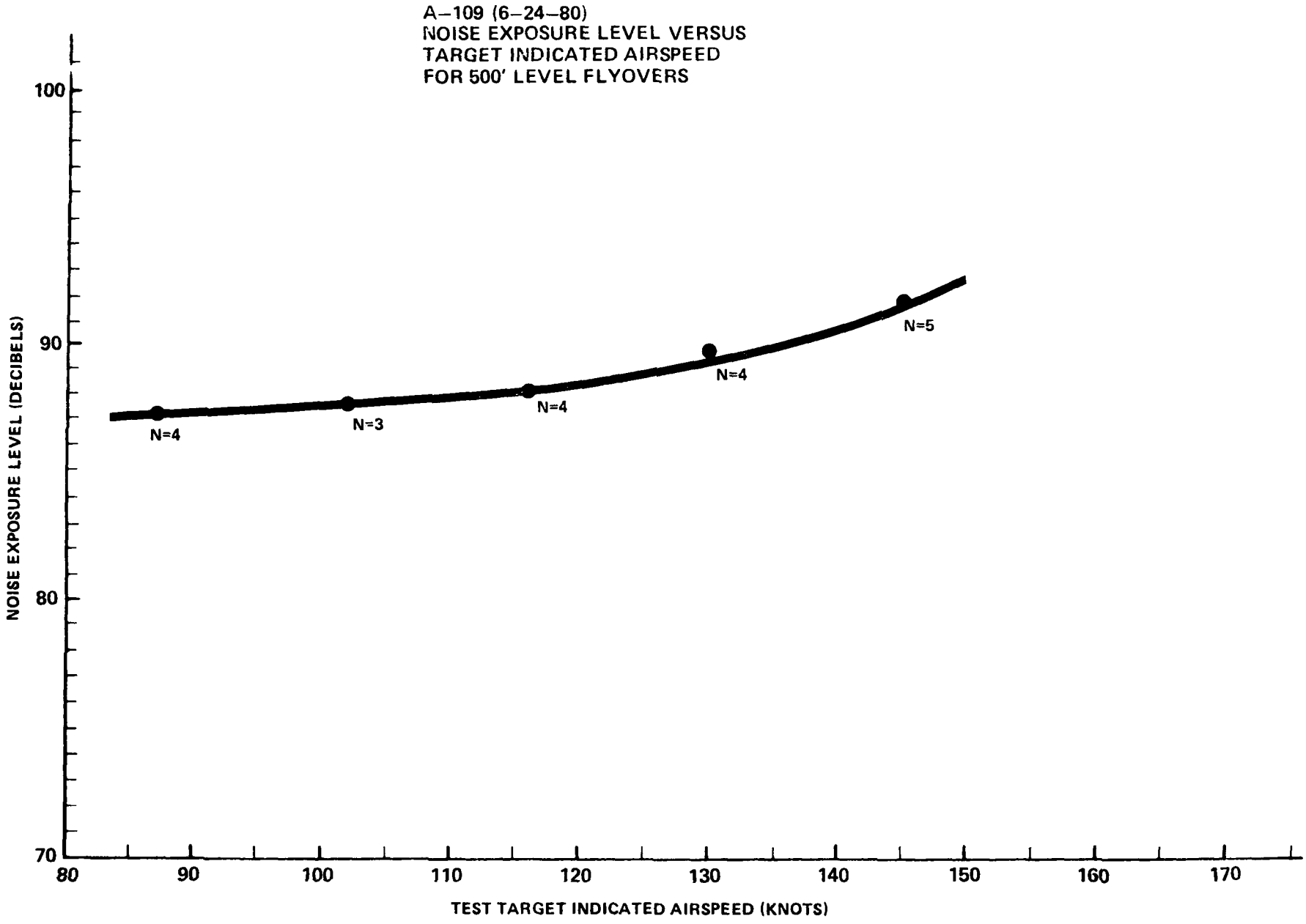
145 Knots			130 Knots			116 Knots		
Run No.	NEL	Max. dB(A)	Run No.	NEL	Max. dB(A)	Run No.	NEL	Max. dB(A)
48	92.6	84.8	17	88.5	80.1	54	89.4	(8[illegible].8)ex
49	91.6	83.7	18	90.7	80.9	55	87.6	78.7
50	-		19	89.4	81.3	57	87.4	78.0
59	91.9	84.4	20	90.9	82.0	58	88.2	79.4
60	92.6	84.0	62	90.8	87.7			
61	91.0	83.5	63	88.8	80.5			
Avg.	91.9	84.1	Avg.	89.8	82.1	Avg.	88.1	78.7
Std.Dev.	.684	.47	Std.Dev.	1.08	.26	Std.Dev.	0.9	.57

$\overline{NEL} - \overline{dB(A)} = 7.8$ $\overline{NEL} - \overline{dB(A)} = 7.7$ $\overline{NEL} - \overline{dB(A)} - 9.4$

102 Knots			87 Knots		
Run No.	NEL	Max. dB(A)	Run No.	NEL	Max. dB(A)
51	-	-	21	86.5	78.3
52	88.4	79.6	22	87.6	77.9
53	86.7	77.7	46	87.9	80.1
56	87.9	79.2	47	86.9	76.9
Avg.	87.6	78.8	Avg.	87.2	78.3
Std.Dev.	.873	.81	Std.Dev.	.639	1.2

$\overline{NEL} - \overline{dB(A)} = 8.8$ $\overline{NEL} - \overline{dB(A)} = 8.9$

Figure 4.3


A–109 (6–24–80)
NOISE EXPOSURE LEVEL VERSUS
TARGET INDICATED AIRSPEED
FOR 500' LEVEL FLYOVERS
NOISE EXPOSURE LEVEL (DECIBELS)
100
90
80
70
N=4
N=3
N=4
N=4
N=5
80
90
100
110
120
130
140
150
160
170
TEST TARGET INDICATED AIRSPEED (KNOTS)

5.0 FAA, BELL 206-L

The Bell 206-L was one of the principal test helicopter participating in the June 1978, FAA measurement program (see FAA-EE-79-03).

In the recently completed test, the 206-L has been used to acquire noise versus distance information.

TABLE 5.1

BELL 206-L: TEST DATE 6/26/80 (THURSDAY)

CENTERLINE CENTER LOCATION (BK)

NOISE EXPOSURE LEVEL

VERSUS DISTANCE

300' AGL			700' AGL			1000' AGL		
Run No	NEL	Max. dB(A)	Run No.	NEL	Max. dB(A)	Run No.	NEL	Max. dB(A)
1	88.1	-	5	84.4	73	9	81.2	70
2	87.7	81.0	6	82.5	73	10	81.2	70
3	88.1	80.5	7	83.8	74	11	81.0	68
4	88.8	81.5	8	83.3	-	12	79.4	69
Avg.	88.1	81.0	Avg.	83.5	73.3	Avg.	80.7	69.2
Std.Dev.	.457	.5	Std.Dev.	.804	0.57	Std.Dev.	.871	0.95

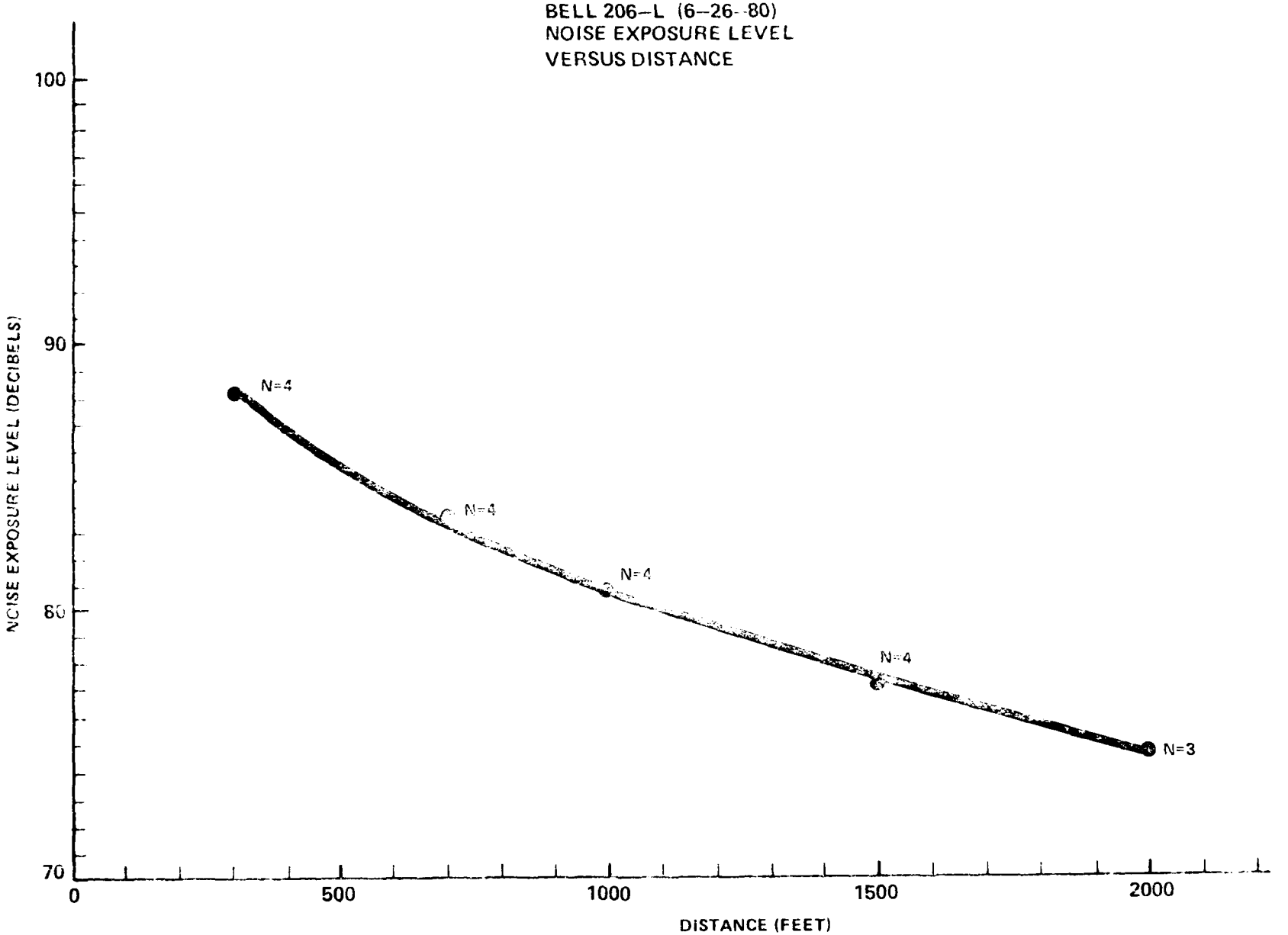
$\overline{NEL} - \overline{dB(A)} = 7.1$ $\overline{NEL} - \overline{dB(A)} = 10.2$ $\overline{NEL} - \overline{dB(A)} = 11.5$

1500' AGL			2000' AGL		
Run No.	NEL	Max. dB(A)	Run No.	NEL	Max. dB(A)
13	78.2	66	17	75.3	62
14	76.4	65	18	74.2	62
15	77.5	64	19	74.7	61
16	76.5	64			
Avg.	77.1	64.7	Avg.	74.7	61.6
Std.Dev.	.858	0.95	Std.Dev.	.550	0.57

$\overline{NEL} - \overline{dB(A)} = 12.4$ $\overline{NEL} - \overline{dB(A)} = 13.1$

Figure 5.1

BELL 206–L (6–26–80)
NOISE EXPOSURE LEVEL
VERSUS DISTANCE




DAT
FILM